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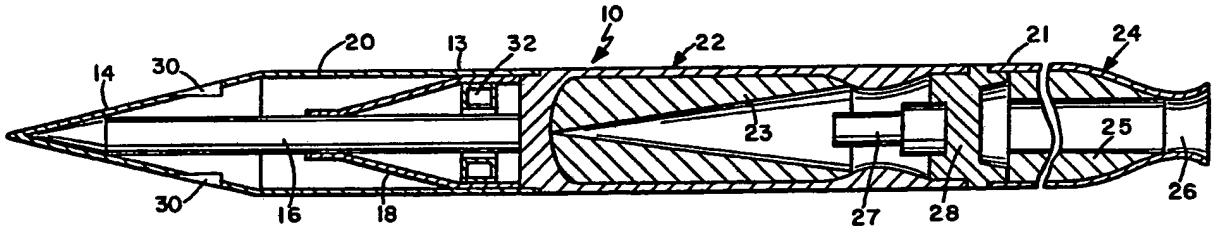
(54) Title: LIGHT ANTI-ARMOR WEAPON



(57) Abstract

A light anti-armor weapon for manual firing via a shoulder held launch tube (36) consists of an outer casing (13) in which a non-explosive, armor-penetrating device, suitably a solid rod (16) f heavy, high density metal r metal composite, is mounted. The penetrating device is mounted in a forward p rtion of the casing while a launch propulsion device (24) is mounted at the rear end for launching the weapon from the launch tube at a first, subsonic launch speed. A second boost propulsion device (22) is mounted in the casing behind the penetrating device f r accelerating the weapon to a second, faster speed sufficient for the penetrating device to penetrate a target, and is associated with an igniter (27) f r actuating the boost propulsion device. A sensor (30) is provided within the missile for sensing when the weapon is a predetermined distance from the target and actuating the igniter (27) at this point.

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LIGHT ANTI-ARMOR WEAPON

BACKGROUND OF THE INVENTION

The present invention relates generally to light anti-armor weapons for manual firing by the soldier from a shoulder-held launch tube.

Current light anti-armor weapons of this type are designed to be used at short ranges for final defense against tanks and other armored vehicles, and utilize shaped explosive charge warheads as the armor penetrating mechanism. One known weapon of this type is the Viper. Advances in armor technology, such as applique armor or composite armors, have severely reduced the effectiveness of such weapons. Another problem is that the warheads are energy limited and require extreme firing precision in order to be effective. Also, the presence of the explosive charge in a manually fired, shoulder held weapon results in a significant risk to the foot soldier firing the weapon.

U.S. Patent No. 4,519,315 of Arszman describes a shoulder fired weapon of this type, in which the explosive warhead must be delivered accurately to a position above the target before being fired.

Another known weapon in use for tank and artillery cannon shells is the so called "Kinetic Energy" penetrator. This consists of a non-explosive penetrator which is fired at a target at sufficient speed to penetrate and damage or destroy the target. In practice, such weapons must be fired at hypersonic velocities of 3 to 4 Km/sec. This makes them completely impractical for a shoulder fired weapon.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved light anti-armor weapon.

According to the present invention, a light anti-armor weapon is provided which comprises an outer casing, a non-explosive armor penetrator mounted at the forward end of the casing, a launch propulsion device mounted at the rear end of the casing for launching the weapon from a shoulder-held launch tube at a first, subsonic launch speed, and a boost propulsion device mounted in the casing between the launch propulsion device and the penetrator for accelerating the weapon to a second, faster speed sufficient for the penetrator to penetrate an armored target. A sensor is provided for detecting when the weapon is a predetermined distance from the target, and for actuating an igniter to fire the boost propulsion device at this point.

In practice, the weapon will preferably be launched at around 300 m/sec, and will be accelerated to a terminal 3 to 4 Km/sec velocity when it is about 6 to 8 feet from the target. The penetrator is suitably a solid rod of heavy metal, such as tungsten or the like or a metal composite following current technological advances of this type, with a pointed forward end. The launch propulsion device or motor preferably separates from the remainder of the weapon on firing of the boost propulsion device.

The launch motor may be equivalent to the launch motors used in current shoulder fired weapons having explosive shaped charges, such as the Viper or Viper Variant. The launch tube used may also be similar to existing launchers

for shoulder fired weapons, but may be made longer if necessary to accommodate the additional length of the armor penetrator rod. The boost propulsion device is preferably a very rapid burning rocket motor for accelerating the weapon to the desired high, "hypersonic" speed.

This weapon therefore allows a foot soldier to fire a non-explosive, kinetic energy penetrator safely and easily, allowing a more effective final defense against armored tanks and the like having armor which will normally defeat shoulder-fired explosive effects weapons. It will be safer to fire than explosive weapons, since it contains no explosive, the rocket motor fuel being the most hazardous substance. Foot soldiers employing a combination of the standard, explosive weapons as well as the non-explosive penetrator weapon of this invention would prove to be substantially more effective against any protected armored vehicle or other target, regardless of the type of armor used.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be better understood from the following detailed description of a preferred embodiment of the invention, taken in conjunction with the accompanying drawings, in which like reference numerals refer to like parts and in which:

Figure 1 is a diagrammatic illustration of the operation sequence of a light anti-armor weapon according to a preferred embodiment of the present invention;

Figure 2 is a cross-sectional view of the weapon; and

Figure 3 is a diagrammatic illustration of the mechanism for sensing approach to the target and firing the boost motor.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 2 of the drawings shows a light anti-armor weapon 10 according to a preferred embodiment of the present invention, which is designed to be launched and fly to a target 12 in the manner illustrated in Figure 1.

The weapon basically comprises a generally cylindrical outer housing or casing 13 having an aerodynamically shaped forward end 14, with a solid penetrator rod 16 mounted coaxially in the casing to project up to its forward end. Rod 16 has a pointed forward end generally shaped to conform to the casing forward end. The rod is held in place by a suitable support structure 18. The casing is preferably formed in two separable front and rear casing sections 20 and 21, which are releasably secured together in a manner known in the missile field. The front section 20 houses the penetrator at its forward end and a boost motor 22 with boost propellant grain 23 at its rear end, while the rear section comprises a launch motor 24 having a propellant grain 25 and outlet nozzle 26. A battery igniter or proximity fuze 27 is associated with the boost motor 22. A suitable barrier or connecting joint 28 is provided between the front and rear sections. This will prevent early firing of the igniter.

A suitable proximity or standoff sensor 30 is mounted at the forward end of the casing to detect approach of the weapon to the target. The sensor is preferably of a commonly known, infra-red sensor type employing reflected infra-red radiation for detecting approach and distance from a target. Such sensors are manufactured by Motorola, for example. The sensor is connected to suitable electronics 32 within the casing, which interprets the sensor output signals in a manner known in the field to produce an output control signal when the weapon is a desired distance from the target 12, as indicated schematically in Figure 3. The output control signal is suitably connected to the boost motor igniter or fuse 27 to ignite the boost motor at the desired distance from the target.

Figure 1 illustrates the use of the weapon in defense against armored vehicles such as tanks. The weapon is designed to be launched by a foot soldier 34 from a shoulder held launch tube 36. The launch motor 24 is preferably a rocket motor of the type generally used in such shoulder fired weapons, for example a Viper or Viper Variant motor, which, when fired, will launch the weapon from the launch tube at a safe, subsonic speed of the order of 900 ft/sec or 300 m/sec.

The weapon will then fly at the subsonic speed towards the target. When the weapon is a predetermined distance from the target, suitably from approximately 6 to 8 feet as detected by the standoff sensor, a control signal will be produced by the sensor electronics 32 to actuate the boost motor igniter to fire the boost motor 22. The boost motor may be any suitable motor capable of accelerating the weapon

up to "hypersonic" speeds of around 3,500 ft/sec or 3 to 4 Km/sec, and is preferably a high thrust, very rapid burning rocket motor capable of producing this increase in speed in a relatively short distance. These speeds are of the order sufficient for penetrator-type weapons to penetrate and damage or destroy an armored target.

The launch motor 24 will be ejected by the ignition of the high thrust boost motor, and the remainder of the weapon will accelerate to fly the remaining distance to the target at the desired high velocity required for the penetrator to function. Since the weapon is not accelerated until it is fairly close to the target, the risk of missing the target is substantially reduced or avoided. The penetrator rod will be of a suitable heavy metal such as tungsten or the like or a composite device. This will result in a weapon carry weight of approximately 10 pounds, with an effective range of 500 meters and a maximum range of 750 meters. On arrival at the target, the hypervelocity penetrator rod will pierce the armor of the target, damaging and potentially disabling it.

The weapon can be fired from a launch tube equivalent to that used in existing shoulder fired weapon systems, although the tube may be made longer to accommodate the additional length of the penetrator rod 16. This weapon substantially improves the effectiveness of shoulder fired weapons, since it is capable of defeating armor types which are not normally penetrated by the standard, explosive charge based weapons. The weapon relies solely on its kinetic energy to damage the target, and thus does not require any explosive charge.

Although a preferred embodiment of the invention has been described above by way of example only, it will be understood by those skilled in the field that modifications may be made to the disclosed embodiment without departing from the scope of the invention, which is defined by the appended claims.

CLAIMS

1. A light anti-armor weapon, comprising:

an outer casing;

a non-explosive armor penetrating device mounted in the casing and projecting to the forward end of the casing;

launch propulsion means mounted at the opposite, rear end of the casing for launching the weapon at a first, subsonic launch speed;

boost propulsion means mounted in the casing behind the penetrating device for accelerating the weapon to a second, faster speed sufficient for the penetrator device to penetrate an armored target;

igniter means for igniting the boost propulsion means; and

sensor means for detecting when the weapon is a predetermined distance from a target and for producing a control signal to actuate the igniter means at said predetermined distance.

2. The weapon as claimed in claim 1, wherein the penetrating device comprises a solid rod of heavy metal.

3. The weapon as claimed in claim 1, wherein the penetrating device comprises a solid rod of metal composite material.

4. The weapon as claimed in claim 1, including means for ejecting the launch propulsion means from the remainder of the weapon on firing of the boost propulsion means so that only the remainder of the weapon flies on to the target.

5. The weapon as claimed in claim 1, wherein the launch propulsion means comprises a rocket motor for firing the weapon at a velocity between 250 to 350 m/sec.

6. The weapon as claimed in claim 1, wherein the boost propulsion means comprises a high thrust rocket motor for accelerating the weapon to a hypersonic velocity.

7. The weapon as claimed in claim 6, wherein the hypersonic velocity is between 3 and 4 km/sec.

8. The weapon as claimed in claim 1, wherein the casing is formed as two separable front and rear sections releasably secured together, the penetrating device and boost propulsion means being mounted in the front section and the launch propulsion means being mounted in the rear section.

9. The weapon as claimed in claim 1, wherein the sensor means comprises means for producing the control signal when the weapon is at a distance of between 6 to 8 feet from the target.

10. A light anti-armor weapon, comprising:

a pair of separable front and rear units releasably secured together in axial alignment;

the front unit carrying a non-explosive, armor-penetrating device at its front end and a boost propulsion means at its rear end for accelerating the front unit to a predetermined hypersonic velocity, and an igniter for firing the boost propulsion means;

the rear unit comprising a launch propulsion means for launching both units at a subsonic speed; and

sensor means for detecting when the weapon is a predetermined distance from the target and actuating the igniter to fire the boost propulsion means and separate the two units at said predetermined distance.

11. The weapon as claimed in claim 10, wherein the sensor means comprises means for detecting when the weapon is around 6 to 8 feet from the target, the launch propulsion means comprising means for propelling the weapon at subsonic speed up to that position.

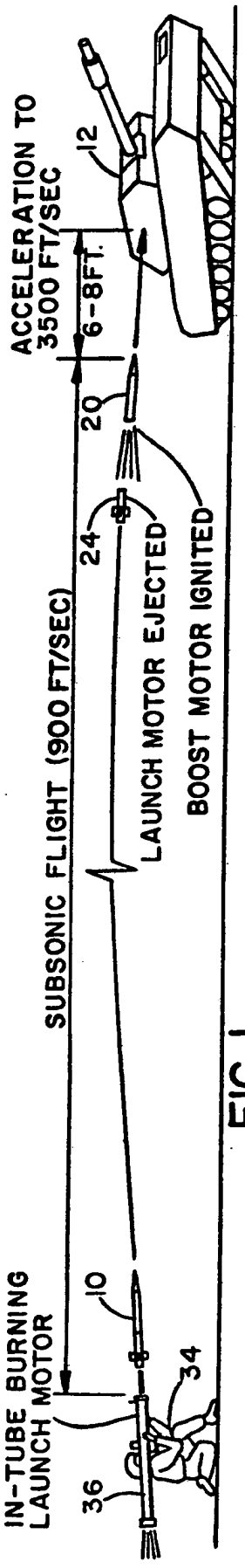

FIG. 1

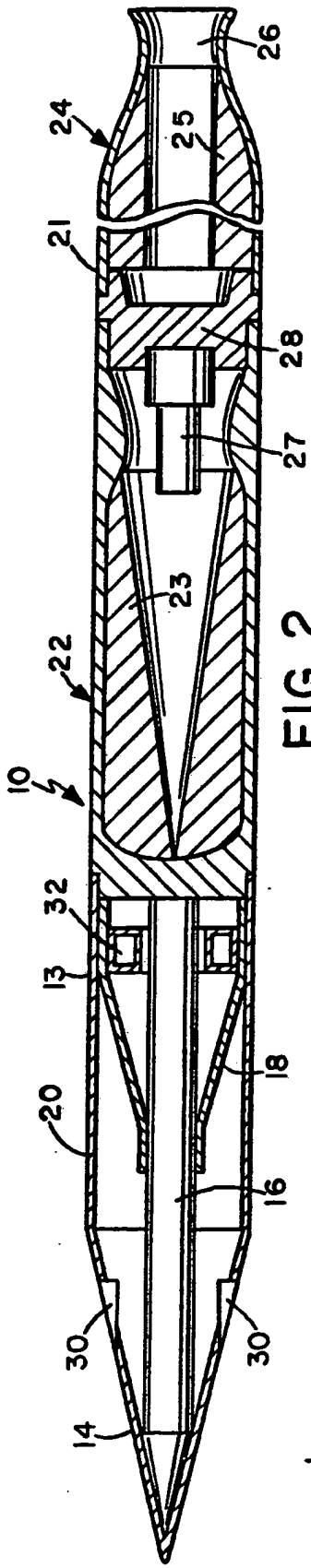

FIG. 2

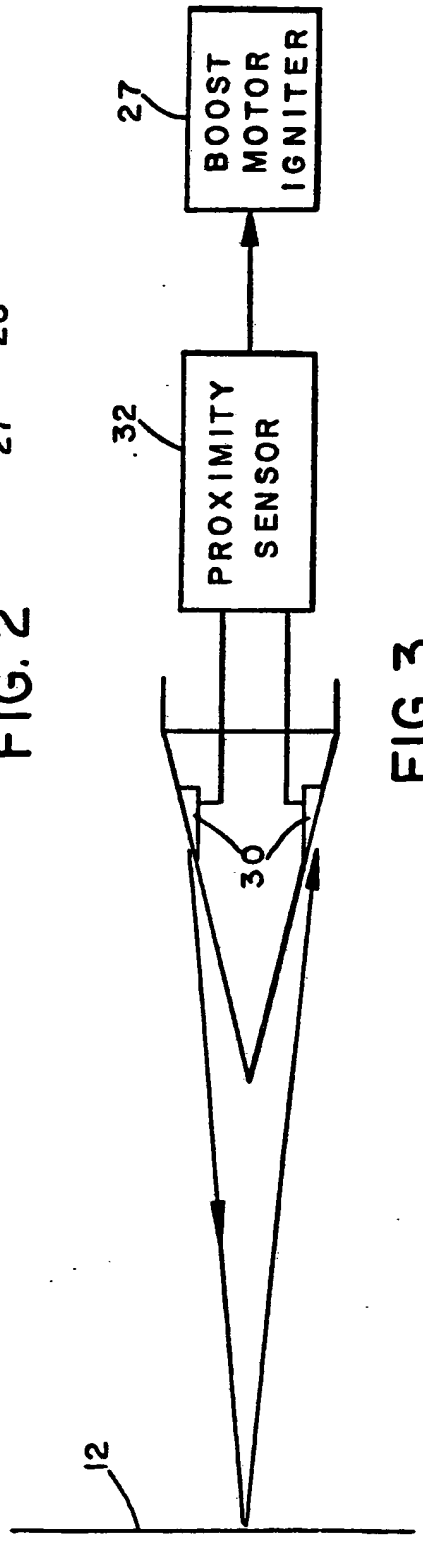

FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 89/02823

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[5]: F 42 B 13/06, 15/00, 15/26

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[5]	F 42 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	FR, A, 2274016 (DYNAMIT NOBEL) 2 January 1976, see page 1, lines 1-3; page 2, lines 38-41; page 3; page 4, lines 1-18; page 7, lines 4-24; figures 1-4	1,2,4,6, 8-11
Y	--	3
Y	US, A, 4441237 (KIM) 10 April 1984, see column 1, lines 53-57; column 2, lines 63-68; column 3, lines 1-10	3
X	-- DE, A, 2500089 (FUSBAN) 8 July 1976, see page 1, last paragraph; page 2, paragraphs 1,4 and 5; page 3, paragraphs 1,5; page 4, paragraph 1; page 5, paragraph 2; figure 2	1,4,5,6
X	-- GB, A, 2110799 (RHEINMETALL) 22 June 1983, see page 1, lines 98-130; figures 1-5	1,2
A	-- US, A, 3566793 (KRUZELL) 2 March 1971, see column 1, lines 3-7, 67-75; column 2, lines 1-34, 51-65; figure 1	1,2,4,8,10

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
28th September 1989	27. 10. 89
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III. DOCUMENTS C NSIDERED TO BE RELEVANT (CONTINUED FR M THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	FR, A, 1209802 (SOC. TECHN. DE RECHERCHES) 3 March 1960, see page 1, left-hand column, paragraphs 1-3; page 2, right-hand column, paragraphs 7-9; page 3, left-hand column; right-hand column, paragraphs 1-3; figure 1 --	1,6,9,11
A	US, A, 3561362 (BLACK) 9 February 1971, see column 1, lines 3-12, 47-75; column 2, lines 1-9, 38-53; column 3, lines 72-75; column 4, lines 1-6; column 5, lines 61-75; column 6, lines 1-52; figures 1-8 --	2,7
A	FR, A, 1413030 (AERO-MECANIQUES) 1965 --	
A	FR, A, 1459597 (PAGET) 18 November 1966 --	
A	US, A, 3935817 (RIPARBELLI) 3 February 1976	

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR-A- 2274016	02-01-76	DE-A- 2427680	18-12-75
US-A- 4441237	10-04-84	None	
DE-A- 2500089	08-07-76	None	
GB-A- 2110799	22-06-83	DE-A,C 2948542	12-04-84
		FR-A,B 2522806	09-09-83
		US-A- 4706569 -	17-11-87
US-A- 3566793	02-03-71	None	
FR-A- 1209802		None	
US-A- 3561362	09-02-71	US-A- 3547031	15-12-70
FR-A- 1413030		BE-A- 654800	15-02-65
		CH-A- 410686	
		DE-A- 1428658	12-12-68
		GB-A- 1021416	
		LU-A- 44772	07-05-65
		NL-A- 6412979	10-05-65
		US-A- 3277825	
		LU-A- 44951	08-06-65
FR-A- 1459597		BE-A- 657225	
		CH-A- 447884	
		US-A- 3349708	
US-A- 3935817	03-02-76	None	

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